



South Carolina Department of Health  
and Environmental Control

## GUIDANCE DOCUMENT: TIER II ASSESSMENT

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## TIER II ASSESSMENT

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## TIER II ASSESSMENT

**I. INTRODUCTION** - This document outlines the Tier II Assessment methodology for sites with petroleum releases from regulated underground storage tanks (USTs) where additional investigation of site-specific conditions is warranted based on existing data from previous investigations. This document establishes performance standards (i.e., describes the minimum elements necessary) for a Tier II assessment while allowing technical flexibility so that the work may be completed in an effective manner.

A. Tier II Assessment Purpose - The purpose of the Tier II assessment is to define the extent of all petroleum CoC (to include RCRA metals for waste oil USTs) as well as identify all current and potential receptors that could be impacted by the release from a regulated UST system. The results of the Tier II Assessment are to be used to establish appropriate site-specific target levels and recommendations for future actions as outlined in the [South Carolina Risk-Based Corrective Action \(RBCA\) for Petroleum Releases](#) document.

B. Tier II Assessment Report Requirements and Responsibilities - All site rehabilitation activities related to a release from a regulated UST system require technical approval by the Department in accordance with applicable state directives. All site rehabilitation activities must be conducted by a SC Department of Health and Environmental Control ([SCDHEC](#)) Class I certified site rehabilitation contractor (the contractor) as required by the State Underground Petroleum Environmental Response Bank ([SUPERB](#)) Site Rehabilitation and Fund Access Regulations, R.61-98, whether reimbursement will be from the SUPERB Account or other financial mechanism. A qualified professional from the company or firm must sign and seal the Tier II Assessment Report and their South Carolina PE or PG certification number and SCDHEC certified Class I site rehabilitation contractor number must be on the signature page of the report. All temporary and other monitoring wells must be drilled under the direction of a licensed class A, B, or C South Carolina Certified well driller. All laboratory analysis must be performed by a South Carolina certified laboratory for the specified parameters. All investigative derived waste must be handled in accordance with applicable state and federal regulations.

The contractor and/or UST Owner/ Operator shall obtain all off-site access agreements and/or encroachment permits necessary for investigation and well installation. The UST Program will assist in acquiring access if all efforts to gain access fail and the tank owner/operator requests assistance from the UST Program in writing. When off-site access assistance is requested, the following items must be provided to the project manager:

1. The property identification to include the tax map number of the property, (e.g., 00020-304-10-01A), and 911 street address, (e.g., 201 South Main).

2. The property owner's complete name, address, and telephone number.
3. A map with the exact location for all proposed temporary screening points or monitoring well locations for each parcel or property. To ensure the exact parcel is identified, the map should clearly show include the distance from properly identified state or county road intersections.
4. Copies of all previous correspondence to the property owner(s), any reply received from the property owner(s).

**II. TIER II ASSESSMENT PLAN** - A concise Tier II plan shall be submitted to the UST Program by the tank Owner/Operator or on their behalf by their site rehabilitation contractor for review and approval prior to implementation. To assist with the preparation of the Tier II Plan, the [Freedom of Information office](#) may be contacted at (803) 898-3882 to access the technical file of the release being investigated if previous site data is not available from the tank owner/operator or if information concerning adjacent UST or AST facilities. A copy of the [Tier II Assessment Plan](#) form, [Analytical Methodology for Groundwater and Soil Assessment Guidelines](#) for sample collection, preparation, and laboratory methods, is available on the [UST Program](#) web page.

The Tier II plan shall include as a minimum:

- A. Site Information - A summary of all general information including Facility Name, Address, Phone Number, and UST Permit number; the name, address, and phone number of the UST Owner/Operator responsible for investigating the release(s); the property owner; the site rehabilitation contractor; and, the well driller. If the tank owner/operator responsible for site rehabilitation is different from the current tank owner, include the name, address, and phone number for the current tank owner.
- B. Maps - This section must include a copy of the relevant portion of a 7.5-minute United States Geological Survey (USGS) topographic map showing the site location, and a scaled site map. The site map shall conform to industry standards and must include as a minimum: a north arrow, a legend, a bar scale, and the date of data collection. Identify the site by the facility name, complete street address, and UST permit number. The map should indicate the location and identity of all on-site and adjacent structures, existing and/or former UST(s), AST(s) and associated underground piping; identify all streets and/or highways; locate property lines, paved areas, and existing monitoring and other wells (e.g. vapor monitoring wells).
- C. Field Screening Methodology - The specific field screening methodology shall be discussed and the proposed number and depth of screening points shall be indicated. As Methyl tert-Butyl Ether (MtBE) and 1,2-dichloroethane (1,2 DCA) are not typically detected above RBSL values using vapor screening instruments, the site rehabilitation contractor should send groundwater samples from selected screening points to a laboratory to ensure the horizontal and vertical extent of petroleum Chemicals of Concern (CoC) are defined prior to installation of monitoring wells. The use of field screening methods to optimize the number and location of permanent monitoring wells is required.
- D. Monitoring Wells - The maximum number and depth of monitoring wells, to include soil borings and temporary wells used for screening, estimated to be necessary to

define the concentrations and extent of free-phase product and groundwater CoC shall be included in the plan. If the contractor later determines this number to be insufficient, additional monitoring wells or additional footage must be requested of the [UST project manager](#). The well screen length should be a minimum of ten feet for shallow wells and five feet for deep wells. However, if the contractor is aware of significant groundwater level fluctuations, a longer screen length may be necessary and shall be specified in the plan. A shallow well will typically be installed adjacent to a surface water body that might be impacted. A shallow and deep monitoring well will typically be installed between the release source and all supply wells that could be impacted as a future compliance point for that receptor. Additional wells require the Department's technical approval as well as financial preapproval if costs are to be reimbursed from the SUPERB Account or will be applied toward a SUPERB deductible. To provide a record of the request by the contractor and approval by the Department, it is recommended that any additions be requested by e-mail to the appropriate UST Project manager.

- E. Implementation Schedule – The contractor proposes a schedule indicating the time frame required for submittal of the Tier II report after notification to proceed from the UST Program. The due date of the report shall be 90 to 100 days from the date of Tier II plan approval unless otherwise designated by the Department. If the work cannot be completed as specified, the UST Project Manager must be notified immediately. A change in the report due date may be issued for work to continue if adequate justification is provided. To provide a record of the request by the contractor and approval by the Department, it is recommended that the appropriate UST Project manager be notified by e-mail.

In some cases, the Department may predetermine a defined scope of work to meet a specific goal(s) (e.g., installation of a compliance well, resample the existing monitoring well network, free product recovery test) and plan preparation by the contractor will not be necessary. In these instances, the UST Program will notify the tank Owner/Operator and his designated site rehabilitation contractor to proceed with the required work and a due date will be assigned.

### **III. TIER II IMPLEMENTATION**

- A. Objectives - The objectives and performance standards of the Tier II Assessment are:
  - 1. To delineate the horizontal and vertical extent of CoC in the soil and groundwater,
  - 2. To identify and evaluate all exposure pathways based on a current survey of existing and potential receptors,
  - 3. To characterize the nature of the CoC present,
  - 4. To define the site geology and hydrogeology, and
  - 5. To use fate and transport analysis to predict the actual or potential impact of CoC on receptors if requested by the Department.

The Department shall allow some flexibility in meeting objective number 5 above, provided that the contractor meets the first four performance standards.

- B. Receptor - Utilities Survey / Site Survey- To successfully complete the receptor and utility surveys the contractor shall:

1. Locate all private and public water supply wells (potable and non-potable) and other potential receptors as defined in the RBCA document (i.e., utilities, surface waters, wetlands, basements) within a 1,000-foot radius of the site or the edge of the plume whichever is farther from the release source. Document the receptor locations in the Assessment Report and depict the locations on the relevant portion of the appropriate United States Geological Survey 7.5 minute topographic map and on the site base map. Provide a table listing the property owner's name, address, and telephone number for each privately owned receptor.
2. Record the current use (residential, commercial, agricultural, industrial) of the site and adjacent land including all properties having a monitoring well associated with this facility. All adjacent properties with tanks (underground, above ground, or heating oil) that are active or closed will be identified. If the tanks are permitted, the applicable permit number(s) will be provided. Information pertaining to any applicable zoning and land use ordinances shall be obtained from local city or county administrative authorities. Zoning ordinances set broad-scale restrictions on property development such as residential, commercial, or industrial. Land use ordinances may establish smaller scale restrictions such as disallowing the installation of a drinking water or irrigation well. A copy of the applicable sections or a summary of the ordinances shall be provided. Additionally, the name, phone number, and business address of the appropriate local authorities shall be provided with a summary of the relevant information. A photocopy of local regulations or ordinances is not required.
3. If not previously submitted, provide a copy of the applicable portion of the county tax map. This map shall depict the location of the facility, all impacted properties, all properties located adjacent to the impacted properties, and any property on which a monitoring well (to include temporary wells) was installed as part of the investigation. Provide a table listing the names and addresses of the owners of each of these properties and the name of all well(s) (e.g., MW-1, MW-12D) on that property or parcel.
4. Locate and report all underground utilities (electrical, natural gas, telephone, water, cable TV, storm drain, and sewer lines) within a 500-foot radius of the site, or 500 feet from the edge of the plume whichever is greater, on a one inch equals 50 foot map unless another scale is approved by the UST Program Manager. Depict all identified underground utilities, both on and adjacent to the property, on a scaled site map to the nearest one-foot. The depth (within 2 feet) also shall be reported.
5. If receptors are identified that may be impacted, immediately screen for hydrocarbons using a properly calibrated screening device. Water samples shall be obtained for all drinking water supply wells and surface water bodies within a 500-foot radius of the site or within 500 feet of the down gradient edge of the plume. The location of these wells will be included on the site map, and well ownership information will be included in an appendix of the report. If field screening or laboratory analysis indicates the presence of CoC, notify the [UST Project Manager](#) within 48 hours of detection at

(803) 896-6241 and provide the name, address, and a contact telephone number for all affected property owner(s). All field-screening and laboratory data for sampling of receptors shall be included in the report of findings.

6. The contractor must provide a comprehensive facility survey if not already completed. A South Carolina Licensed Land Surveyor must perform the survey. The scale of the surveyed map should be one inch equals 50 feet unless the UST Project manager previously approved another map scale. The surveyor's certification number, business address, telephone number, and date of survey must be on any applicable maps. The 500-ft by 500-ft foot survey shall include, at a minimum:

- a. The locations and relative elevations of potential receptors
- b. Existing or former USTs
- c. UST lines
- d. UST dispensers
- e. Field screening points
- f. Soil borings
- g. Wells (monitoring, vapor wells), and
- h. Other above and below ground structures

Only one comprehensive survey will be required per Tier II Assessment for surveyed areas up to 250,000 square feet (approximately 500 x 500 feet). If the area was previously surveyed, only a subsequent survey to locate new soil borings, or monitoring wells on the original survey plat will be required.

- C. Soil Boring Installation, Sampling, and Analysis - If not previously defined and quantified, the horizontal and vertical extent of impacted vadose zone soil contamination shall be fully delineated according to the following:

- 1. Install soil borings as follows:
  - a. UST Area: Install soil borings to a depth of 25 feet or to the groundwater table, whichever is shallower, in the area formerly occupied by the USTs or adjacent to the currently operating USTs. Soil samples shall be collected at the surface and at five-foot intervals to the boring terminus. DO NOT COLLECT SOIL SAMPLES BELOW THE WATER TABLE.
  - b. Piping and Dispenser Area: Install borings to a depth of ten feet or to the groundwater table, whichever is shallower, in the area formerly occupied by the lines and product dispensers or adjacent to the currently operating product lines and dispensers. Soil samples shall be collected at the surface and at two-foot intervals to the boring terminus. DO NOT COLLECT SOIL SAMPLES BELOW THE WATER TABLE.
  - c. Background Soil Boring: Install one soil boring to a depth of 10 feet or to the groundwater table, whichever is shallower, at least thirty feet away from any USTs, product lines, dispensers, and other potential sources of CoC. If the site is too small to allow a separation of thirty feet, install this soil boring as far away from all USTs, product lines, dispensers, and other potential sources of CoC

as possible. Collect a soil sample from below the A horizon unless precluded by a shallow water table. DO NOT COLLECT SOIL SAMPLE BELOW THE WATER TABLE.

- d. If the Extent of Soil Contamination is not Defined by the borings described above, continue moving away from the area of contamination and installing borings to a depth of ten feet or to the groundwater table, whichever is shallower until the extent of soil contamination is defined. Soil samples shall be collected at the surface and at two-foot intervals to the boring terminus. DO NOT COLLECT SOIL SAMPLES BELOW THE WATER TABLE.

2. Soil Sample Descriptions:

- a. Describe the lithology for each soil sample collected during boring installation. Screen for organic vapors utilizing properly calibrated instruments (for other less volatile chemicals such as diesel or kerosene, alternative screening methods such as Field Gas Chromatograph, or immunoassay shall be used).
- b. On a separate log for each boring, record the soil type, color of soil using standard methods, rocks or minerals present, split-spoon sample intervals, and any organic vapor and field screening measurements. Additionally, a qualitative indication of soil conditions (dry, moist, wet, saturated) shall be noted on the logs. The boring logs shall note the depth of each sample submitted for analysis.

3. If not previously conducted, the soil sample from each boring around the USTs, piping, dispensers, or other area with the highest organic vapor measurement shall be submitted to a Department certified laboratory for analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX), naphthalene, PAHs, and total lead. Samples from sites with a waste oil release shall also be analyzed for the 8 RCRA metals (lead, mercury, arsenic, barium, cadmium, chromium, selenium, and silver). All industry standard quality assurance and quality control methods shall be followed for sample collection and shipping (sample labels, sealed sample containers, completed chain of custody forms, shipment to the laboratory on ice). Refer to [Analytical Methodology for Groundwater and Soil Assessment Guidelines](#) for collection and preservation methods as well as analytical parameters and other requirements.

In addition to the samples described above, if not previously conducted, the one soil sample collected from the boring that exhibited the highest organic vapor measurement (not from a background boring) shall be forwarded to a certified laboratory for a grain size/hydrometer analysis to determine the sand, silt and clay fractions at 0.074 millimeters (#200 screen) and 0.004 millimeters respectively. A second soil sample shall be collected from above the groundwater table and analyzed for Total Petroleum Hydrocarbons (TPH) using Environmental Protection Agency (EPA) method 3550. Additional soil samples above or below the water table may be submitted to a certified laboratory for grain/sieve analysis, TPH or TOC; however, the Department must preapprove these samples.



In addition, a soil sample collected from the background soil boring shall be analyzed for total organic carbon (TOC) as outlined in *Analytical Methodology for Groundwater and Soil Assessment Guidelines*.

**If the collection location, collection methods, laboratory methods, and/or detection limits for soil or groundwater are not below the risk-based screening levels (RBSL) as outlined in Appendix B of *South Carolina Risk Based Corrective Action for Petroleum Releases* and Tables of *Analytical Methodology for Groundwater and Soil Assessment Guidelines*, the Department cannot consider a closure or no further action decision.**

4. Soil Boring Abandonment - All soil borings and screening points shall be properly abandoned with neat cement grout as regulated by the South Carolina Department of Labor, Licensing, and Regulation and in compliance with the South Carolina Well Standards and Regulations [R.61-71](#).
- D. Soil Leachability Model - If requested by the Department and not previously calculated, calculate the site-specific target levels (SSTLs) for each CoC in the soil. The Soil Leachability Model provided in the RBCA document shall be utilized unless an equivalent method is approved. Model input parameters and results shall be recorded on the appropriate forms found in the RBCA document. The calculated groundwater SSTLs shall be used to calculate soil SSTL values. If groundwater is less than 5 feet below ground surface (bgs), the Soil Leachability Model is not required.
- E. Field Screening - The contractor shall propose in the Tier II Assessment plan appropriate sample collection methodology and field screening techniques based on the anticipated CoC. The method for sample collection and the field screening technique shall be at the discretion of the consultant. The objective of field screening is to adequately delineate the horizontal and vertical extent of any free phase petroleum and petroleum constituents in soil and groundwater and to use the field screening results to optimally locate the monitoring wells. Field screening locations, field sampling results, and proposed monitoring well locations must be provided to the DHEC project manager for approval prior to the installation of permanent wells. As Methyl tert-Butyl Ether (MTBE) and 1,2-dichloroethane are not typically detected using standard screening instruments, the site rehabilitation contractor should select groundwater samples from selected screening points for certified laboratory analysis to ensure the horizontal and vertical extent of petroleum CoC are defined prior to installation of monitoring wells. Shallow screening should concentrate on defining the edges of the plume laterally (to include up gradient of the source), between the source and receptors (wells, surface waters, and utilities) to determine if a preferential pathway exists, and define strata with high hydraulic conductivity (sand stringers, gravel beds). **The contractor or their subcontractors shall not access private property, roads shall not be cleared, nor vegetation cut without the property owner's written consent.**
  1. Methods -Typical methods of screening include one or a combination of one of the following:
    - a. Standard screening method will ensure the extent of CoC is defined by submitting selected vertical and down-gradient groundwater

samples to a certified laboratory for analysis. To be considered defined, the laboratory analysis should provide results at or below the RBSL for each CoC. The screening and laboratory results will be submitted to the appropriate project manager before monitoring wells are installed.

- b. Alternative screening method will use an on-site semi-quantitative analytical method(s) that is capable of detecting benzene, naphthalene, and MtBE without sending screening samples to a certified laboratory. The method(s) will be capable of providing real-time on-site data; i.e. the data is obtained as borings are advanced or within 30 minutes of sample collection. Typical instrumentation includes, but is not limited to, field gas chromatography and/or other methods that would provide detection limits at or below the RBSL for benzene, naphthalene, and MtBE as a minimum. The method(s) used and the results will be submitted to the appropriate project manager to determine well locations and included in the report.
  - c. Fractured Rock screening will use methods to identify individual fractures or zones containing a series of fractures. Fractures may be identified by use of calipers, gamma logs, temperature sensors, flow sensors, video cameras or other in-bore methods and techniques. The goal will be to locate all fractures 0.01 foot or larger, the orientation of the fracture(s) in an individual boring, and collating fractures over the entire site if multiple wells or borings are logged at the site as well as the reporting of this data. The method(s) used and the results will be submitted to the appropriate project manager to determine screen locations in the core hole or if the core hole should be abandoned.
2. Procedures –Typically the following steps will be used for groundwater screening:
- a. Prior to advancing the first field screening point, the depth to groundwater shall be gauged in existing monitoring well(s).
  - b. The initial field screening points should be installed in a radial pattern beginning in the immediate vicinity of the suspected source(s). These field screening points shall not be advanced deeper than five feet below the water table as gauged in existing wells and shall delineate the horizontal extent of free phase product and dissolved CoC at the water table. A series of temporary wells may be appropriate to define the extent of free phase product. If advancement refusal is encountered at multiple points, the UST Program Manager should be called to determine if field screening should be continued.
  - c. Once the upper horizontal extent of the plume has been identified, a minimum of three deeper field screening points shall be advanced to determine the vertical extent of CoC in the soil and groundwater. These points shall be located along the plume centerline and shall be located at the source, the mid-point of the plume, and at the downgradient boundary of the plume. Water samples shall be

screened for petroleum constituents at five-foot intervals and at any discernable changes in soil type with a properly calibrated field screening instrument. Changes in soil type can be identified utilizing well logs from existing monitoring wells or based on significant changes in the advancement rate of the field screening points. The deeper field screening points shall be terminated at advancement refusal or upon two consecutive samples below risk-based screening levels, whichever is shallower.

- d. The remaining field screening points for horizontal delineation shall be advanced to the depth that exhibited the highest results in the deeper field screening points. For example, if the highest concentration of petroleum is present in a sand stringer located eight feet below the water table, then additional field screening points shall target that stratigraphic interval.
- e. The contractor shall provide the following QA/QC information in their Tier II Assessment plan.
  - 1) FIELD INSTRUMENT - The brand name, model number, and serial number for each instrument utilized.
  - 2) FIELD CALIBRATION - Written verification of the calibration of the instrument in the field for each day of reported analysis. This shall include the method of calibration, the concentration(s) and composition of the standard, and the existing conditions at the time of calibration (temperature, humidity, etc.). This calibration shall be accomplished using a standard indicative of the constituents being tested for (i.e., if analyzing for gasoline, calibrate the instrument with gasoline). This allows the method to provide measurements of the actual concentration of the subject constituent (parts per million TPH as Gasoline) instead of span gas equivalents.
  - 3) FIELD ANALYTICAL METHOD - This shall include protocols for sample collection and handling, as well as a detailed description of the field analysis. This shall also include information pertaining to the basis for the method and how it works.
- f. Abandonment of temporary soil borings, field screening points, and core holes shall be by forced injection or tremie grouting of neat cement from the termination depth of the boring/point to within three inches of the surface or up to six inches in a high traffic area under the supervision of a South Carolina certified well driller. The upper three inches of each boring or up to six inches in a high traffic area that is not completed as a monitoring well, shall be filled with a material comparable to the surrounding material. For example, an asphalt plug should be placed in the upper three inches of a boring advanced in an asphalt parking lot, and a native soil/grass plug may be used in the upper three inches of a boring advanced in a grassy area.

- g. Any reference, or lack thereof, to any specific assessment or remedial technology does not constitute an endorsement or recommendation by the Department. Technologies are discussed for illustrative purposes only. Any technology, which accomplishes the Tier II performance standards and meets all regulatory requirements is acceptable.
- h. **Field screening results (OVA and laboratory data), along with proposed monitoring well locations, are to be faxed to the UST project manager at (803) 896-6245 before installation of monitoring wells for location approval.**

F. Install monitoring wells - The number and location of the monitoring wells shall be based on field screening results and only after the approval of the UST Project Manager. The wells shall be installed in locations that fully delineate the horizontal and vertical extent of the groundwater CoC so that all exposure pathways can be monitored. The monitoring wells shall define the extent of the CoC to the maximum extent possible without the installation of unnecessary monitoring wells.

1. Monitoring wells must be installed as regulated by the South Carolina Department of Labor, Licensing and Regulation and be constructed in compliance with South Carolina Well Standards, R.61-71. The wells shall require proper filter pack, grout, locking well cap, well pad at or above the land surface, data plate, and a cover held in place with bolts or screws. During well installation, soil samples are to be collected for screening at five-foot intervals. The soil lithology of each sample is to be recorded on a drilling log. The log shall contain the soil type, color of soil using standard methods, rocks or minerals present, split-spoon sample intervals, and any organic vapor and field screening measurements. Additionally, a qualitative indication of soil conditions (dry, moist, wet, saturated) shall be noted on the log. The boring log shall note the depth of each sample submitted for analysis. Enclose the boring log and signed [DHEC Form 1903](#), *Water Well Record* as attachments to the Report of Findings.
2. A minimum of two vertical assessment wells shall be proposed unless the vertical extent of the contamination can be reasonably determined, or estimated, by another method and/or if the geology precludes the potential of vertical migration of the CoC. The deep wells are to be paired with water table wells (preferably the water table well with the highest concentration of CoC and another water table in the center part of the down gradient portion of the plume) to determine vertical extent of the CoC and the vertical hydraulic gradient. The diameter of the deep well boring must be such that installation of the telescoping monitoring well can easily be accomplished. A six-inch ID well casing shall be advanced at least ten feet deeper than the bottom of the adjacent water table well screen or to the first confining unit, whichever is less. The well screen length shall typically be five feet. The well will be installed as regulated by the South Carolina Department of Labor, Licensing and Regulation and be constructed in compliance with South Carolina Well Standards, R.61-71.
3. Unnecessary monitoring wells shall not be installed (e.g., wells installed a significant distance beyond and existing temporary or permanent well that

exhibits no appreciable concentration of CoC or deep wells installed where groundwater analyses indicated minimal concentration of CoC in the shallow monitoring wells).

4. All soil cuttings and groundwater generated during boring construction and monitoring well development/purging shall be temporarily stored in 55-gallon drums or other suitable containers and removed for disposal within 90 days of generation.
  5. If free product is not encountered, the well shall be properly developed prior to sampling and the pH, temperature, dissolved oxygen, and specific conductance measured and reported. Development will be considered complete once enough solids, drilling muds and fluids have been removed to provide relatively sediment-free groundwater samples that are typical of the aquifer.
  6. Depth to water (or product) shall be determined using equipment capable of detecting the free product/water interface prior to development. If free product is present, the apparent thickness to 0.01-foot accuracy shall be measured.
- G. Groundwater Sampling – Groundwater samples should be collected after each new groundwater-monitoring well is developed and allowed to equilibrate for a minimum of twenty-four (24) hours.
1. If the monitoring well contains free product exceeding 0.01 feet (1/8 inch), a sample shall not typically be collected. If free product is encountered, please contact the appropriate UST project to determine if a product bail down test, collection of a product sample for product aging, and/or collection of a groundwater sample below the product will be required.
  2. The well shall be purged prior to sampling with pH, temperature, dissolved oxygen, and specific conductance of the groundwater monitored and recorded. Purging is considered complete once the groundwater temperature and pH measurements have equilibrated. Field data sheets documenting purging volumes and parameters measured shall be included as an attachment to the report of findings. All purge water shall be containerized and disposed of as appropriate. Once laboratory analysis for soil and groundwater is received, the UST Program manager may be contacted to see if on site disposal is appropriate.
  3. If the well is an existing well and the screen brackets the water table then the dissolved oxygen level will be recorded and the groundwater collected without purging the well.

4. If the well is an existing well and the screen does not bracket the water table (e.g., deep or pit cased well) then the well shall be purged prior to sampling and the pH, temperature, dissolved oxygen and specific conductance recorded. Purging is considered complete once the groundwater temperature and pH measurements have equilibrated. Field data sheets documenting purging volumes and parameters measured shall be included as an attachment to the report of findings. All purge water shall be containerized and disposed of as appropriate. Once laboratory analysis for soil and groundwater is received, the UST Program manager may be contacted to see if on site disposal is appropriate.

H. Groundwater Analysis - The groundwater samples shall be submitted to a South Carolina certified laboratory for analysis of:

|  |                                 |
|--|---------------------------------|
| Benzene                                  | <b>Oxygenates:</b>              |
| Toluene                                  | Methyl tert-Butyl Ether (MTBE)  |
| Ethylbenzene                             | Ethyl Tert-butyl Alcohol (ETBA) |
| Xylenes                                  | Ethyl Tert-butyl Ether (ETBE)   |
| Naphthalene                              | Tert-amyl Methyl Ether (TAME)   |
| Polynuclear aromatic hydrocarbons (PAHs) | Tert-butyl Alcohol (TBA)        |
| Nitrates                                 | Tert-amyl Alcohol (TAA)         |
| Sulfates                                 | Tert-butyl Formate (TBF)        |
| Ferrous iron                             | Ethyl Tert-butyl Alcohol (TBA)  |
| Methane                                  | Di-isoproyl Ether (DIPE)        |
| Ethyl Dibromide (EDB)                    |                                 |
| 1,2 Dichloroethane (1,2 DCA)             |                                 |

Samples from sites with a waste oil release shall also be analyzed for the 8 RCRA metals (lead, mercury, arsenic, barium, cadmium, chromium, selenium, and silver).

All industry standard quality assurance and quality control methods shall be followed for shipping (sample labels, sealed sample containers, completed chain of custody forms, shipment to the laboratory on ice). Refer to *Analytical Methodology for Groundwater and Soil Assessment Guidelines* for collection and preservation methods. **The elapsed time between the collection date of the groundwater samples and the received date of the report will be no more than 60 days.**

- I. Aquifer Characteristics - Determine aquifer characteristics. The completion of a pumping test is preferred whenever possible. In cases where a pumping test cannot be conducted because of technical (e.g., well yields are too low) or financial (e.g., wastewater disposal is cost-prohibitive) reasons, aquifer slug tests shall be acceptable. All wastewater generated during aquifer tests shall be properly containerized and disposed.
  1. Slug Tests – Typically at least three separate slug tests shall be conducted in different on-site wells to determine aquifer characteristics unless otherwise specified by the Department. At least one slug test shall be conducted in a deep well. Data shall be analyzed in accordance with industry standards (Horslev, Bower and Rice, etc.). The slug test shall be reported on the Summary of [Slug Test form](#). The form is included in an appendix to this document and also is available on the UST Program web page.

2. Pumping Test - To ensure that the pumping test data is representative, the test shall be conducted using a sufficient pumping rate and duration to stress the aquifer. Therefore, the pumping test shall have a duration of at least six hours to a maximum of twenty four hours based on site-specific data. Data shall be reported and analyzed in accordance with industry standards. Generation of more than 5,000 gallons of wastewater during a pumping test will require a general discharge permit from the Bureau of Water.
- J. Free Product Recovery Test - If 0.2 foot or 2.4 inches or more of free product is encountered in a non-temporary monitoring well, then a recovery test or bail down test shall be conducted using current industry standards to determine free product recovery rates and true thickness. This data shall be submitted on a graph as an appendix to the report.
- K. CoC Fate and Transport - If requested by the Department and not previously calculated, calculate the SSTLs for each CoC for groundwater and for vapors. The contractor shall specify in the [Tier II Assessment Plan](#) the model or method proposed if fate and transport modeling is requested by the UST Program manager. The completion of a relatively simple mathematical and/or algebraic or semi-analytical expression shall be preferred initially. Where a completed pathway may exist, a more complex computer model shall be used.
1. Mathematical and/or algebraic or semi-analytical expressions. For groundwater, the contractor shall utilize Domenico's Fate and Transport Model provided in the RBCA document or equivalent model. RBSL values should not be recalculated, if values are listed in Appendix B of the RBCA document.
  2. Computer fate and transport modeling. For groundwater, the contractor shall utilize SOLUTE, AT123D, BIOPLUME-II, or equivalent model. For vapors, the contractor shall utilize Farmer, Thibodeaux-Hwang, SeSoil, Jury, Box, or an equivalent model.
- L. Tier 2 Risk Evaluation - Use the historical data and the information obtained during this scope of work to perform a Tier 2 Risk Evaluation. This evaluation includes, but is not limited to, the establishment of exposure points (current and future/potential receptors), site-specific target levels, and points of compliance and recommendations for future actions. This evaluation shall be performed in accordance with the RBCA document. The UST Project Manager must approve prior to modeling the receptor(s) and the model(s) to be used. Only one tier evaluation will be required for a facility unless new receptor(s) are identified.
- M. Final Survey - A final survey to tie-in field screening points and permanent monitoring well locations and elevations to a common elevation datum shall be performed. A subsequent survey may be performed by the contractor.
- N. Waste Disposal - Sample, analyze, transport, and dispose of any soil or wastewater generated in accordance with the Department's guidelines. Sampling and disposal shall be the responsibility of the contractor. It is the responsibility of the contractor to acquire signatures for the disposal manifests. Categories of waste disposal include:

1. Wastewater - Water generated from well development, purging and/or sampling, or water generated from aquifer testing.
  2. Free Product - any product recovered from the sub-surface.
  3. Soil - soil that requires treatment in concurrence with the Department.
- O. Management of data and methods. If the analytical method detection limits for soil or groundwater are above the risk-based screening levels (RBSL) as outlined in Appendix B of RBCA, or the horizontal and vertical extent of the plume are not defined, the Department cannot consider a closure or no further action decision. The UST project manager shall be notified at (803) 896-6241 at the earliest opportunity if any water samples are collected within a 500-foot radius of the edge of the plume.

**IV. Tier II Assessment Report** - A final report of findings (one hard-copy and one electronic copy, at a minimum) shall be submitted to the UST Program in accordance with the implementation schedule provided in the plan and approved by the Department. The hard-copy report will have two-sided copies for text, analytical data, boring logs, field measurements, aquifer test data, modeling results, etc. A Professional Engineer or Geologist registered in the State of South Carolina associated with the DHEC certified site rehabilitation contractor's firm must sign and seal the report. The contractor will submit both the paper and an electronic copy (CD-Rom) of the report. The electronic copy will have all text in a Microsoft Word format; all tables in a Microsoft excel format, and all pictures, maps, figures, or other graphic information in an Adobe Acrobat (PDF) or other compatible software in the original format if at all possible. A scope of work less than a complete report (e.g. install one deep well, resample all wells) directed by the UST Program Manager will typically not require an electronic copy in addition to the signed paper copy. The report shall include, at a minimum, the following elements:

A. Introduction

1. UST Facility Name, Permit Number, Address, and Phone Number. UST Owner/Operator's (if different from Owner) Name, Address, and Phone Number.
2. DHEC Certified UST Site Rehabilitation Contractor's Name, Address, and Certification Number and Well Driller's Name, Address, and Certification Number.
3. Facility history including tank information (number, size, and contents of all current and former USTs), date release reported to DHEC, estimated quantity of release, cause of release (if known), and status of any other releases at the facility. If the facility is no longer a petroleum marketing facility, please provide the current facility name and use. If the facility is currently not in use, please list the current use as vacant.
4. Regional geology and hydrogeology.
5. Receptor survey results - the results shall include all known groundwater quality and public and private groundwater usage.
6. Site location maps - the report shall include a copy of the relevant portion of a USGS topographic map showing the site location and the locations of all public and private water supply wells and other potential receptors within



1,000 feet of the site or the down-gradient edge of the plume whichever is greater. A copy of the relevant portion of the tax map depicting the location of the facility, all impacted properties, and all properties located adjacent to the impacted properties shall also be included. The property owner names, addresses, and phone numbers as well as a list of monitoring wells installed on each parcel should be included in tabular format. The report shall also include a scaled site vicinity map that indicates site location, surface drainage, structures, roads, receptors, and adjacent property uses. (Maps should not be integrated in the report; they may be included as an attachment or appendix at the end of the report.)

B. Assessment Information

1. Site-specific geology and hydrogeology.
2. Site potentiometric map - the map shall indicate the water level elevations for each monitoring well and show the direction of groundwater flow for the surficial aquifer.
3. Potentiometric data for the site shall be listed in tabular form.
4. Assessment results - the report shall include a brief discussion of the assessment and results. The discussion shall include any methodology used that is not outlined in the Tier II Assessment plan.
5. Site assessment map - the report shall include a surveyed map (scaled to one inch equals fifty feet) that shows structures, underground utilities, potential receptors, USTs and associated piping and dispensers, and the locations of all sampling points and monitoring wells for a minimum distance of 500 by 500 feet with the UST facility in the center of the map. The site assessment map shall be certified by a South Carolina Licensed Professional Land Surveyor or if the map is derived from a certified survey map, then a copy of the survey map shall be included in a report Appendix.
6. CoC site maps - the maps shall show the known and estimated horizontal extent of CoC in the soil and groundwater. Analytical values for the CoC shall be indicated at each sampling point. A separate map shall be used for each medium. The analytical data should be adjacent to the relative sampling point and should use the following format (additional parameters such as dissolved oxygen may be required):

|                              |                |
|------------------------------|----------------|
| Sample ID (MW# or SB#)       | 1,2 DCA (µg/l) |
| Benzene (µg/kg or µg/l)      | ETBE (µg/l)    |
| Toluene (µg/kg or µg/l)      | ETBA (µg/l)    |
| Ethylbenzene (µg/kg or µg/l) | TAME (µg/l)    |
| Xylenes (µg/kg or µg/l)      | DIPE (µg/l)    |
| Naphthalene (µg/kg or µg/l)  | TBF (µg/l)     |
| Total Lead (µg/kg or µg/l)   | TBA (µg/l)     |
| RCRA Metals (µg/kg or µg/l)  | TAA (µg/l)     |
| EDB (µg/l)                   |                |

Note: Not all parameters apply. Please see *Analytical Methodology for Groundwater and Soil Assessment Guidelines* for specifics. If the laboratory analysis indicates all CoC at or below detection limits "ND" may be listed on the map beside that boring or monitoring well.

7. Geologic cross-sections - the report shall include two cross-sections showing the lithology and stratigraphy of the site, and the known and estimated vertical extent of CoC in the soil and groundwater. The cross-

sections shall intersect at a 90-degree angle if possible. One cross-section shall include the source area and down-gradient through as many wells as practicable with the highest concentrations. If a subsequent assessment is conducted to define the extent of CoC, the cross-sections will be updated to include the additional wells.

8. Analytical data - soil and groundwater analytical data for the site shall be given in tabular form for this and all previous sampling event(s).
9. Aquifer evaluation results - the report shall include a brief discussion of the aquifer evaluation and results. All data, graphs, and equations used to derive the aquifer characteristics shall be included in the report appendix.
10. Aquifer characteristics - hydraulic conductivity, seepage velocity, etc. shall be summarized on the appropriate DHEC form.
11. If requested by the UST project manager, a brief description of the fate and transport model(s) used shall be presented. All assumptions shall be clearly identified. The input parameters are to be given in tabular form. The method of model calibration for each CoC shall be discussed.
12. A map or series of maps showing the predicted migration and attenuation of the CoC through time shall be presented. Total BTEX and TPH maps will not be used.

C. Tier 2 Risk Evaluation (If requested by the UST Project Manager)

1. Exposure pathway analysis. It is recommended that the site rehabilitation contractor fax all screening data, receptor locations, exposure points, and compliance points to the project manager at (803) 896-6245 prior to the start of exposure modeling. The tier analysis shall be done in accordance with the [RBCA](#) document.
2. SSTLs shall be calculated for each CoC and for each potential vapor, soil, and groundwater exposure pathway. Results shall be tabulated.
3. Recommendations - The report shall include recommendations for further action (Tier 3 assessment, active remediation, intrinsic remediation, etc.) as warranted by the Tier 2 evaluation.

D. Appendices – The report shall contain, at a minimum, the following information in the appendices:

1. Site Survey prepared by a South Carolina Licensed Professional Land Surveyor (if appropriate);
2. List of adjacent property owner and well owners with their information. Attach in this appendix a copy of all signed right of entry forms
3. Soil Boring/Field Screening logs for Temporary Wells and Screening Points to include [DHEC Form 1903](#) for any abandoned temporary borings or wells;
4. Well completion logs and SCDHEC Form 1903 for all well(s);
5. Sampling logs, laboratory data sheets and chain-of-custody forms
6. Aquifer evaluation summary forms, data, graphs, equations

7. Disposal manifests; and,
8. If requested by the UST Program Manager, all fate and transport modeling assumptions, data input to each model, and all generated output data.

The following references are available at the [UST Program](#) web page

[South Carolina Risk Based Corrective Action \(RBCA\) for Petroleum Releases Analytical Methodology for Groundwater and Soil Assessment Guidelines Tier II Assessment Plan](#) (Online ready)

The following Formats are included in the Appendix to this document.

Tier 2 Risk Evaluation:

- Current Land Use, Future Land Use
- Utilities Survey Format and Potential Receptor Format

Soil Boring Data

Temporary Well / Screening Point Data

Adjacent Property Owner Information

Groundwater Sampling Summary

Purged Monitoring Well Data

## APPENDIX

## Tier 2 Risk Evaluation

- A. **CURRENT LAND USE** - Identify any potential receptors or human exposure pathways (e.g. basements, contaminated soils from UST closures, etc.) within a 1000-foot radius for current land use. Complete the table below. Additional sheets may be attached if necessary.

| Media<br>(for exposure) | Exposure Route              | Pathway Selected for<br>Evaluation? (Yes or<br>No) | Exposure point or<br>Reason for<br>Non-Selection | Data Requirements<br>(IF pathway<br>selected) |
|-------------------------|-----------------------------|--|--|---|
| Air                     | Inhalation                  | Yes      No  |  |   |
|                         | Explosion<br>Hazard         | Yes      No  |  |   |
| Ground-Water            | Ingestion                   | Yes      No  |  |   |
|                         | Dermal Contact              | Yes      No  |  |   |
|                         | Inhalation                  | Yes      No  |  |   |
| Surface Water           | Ingestion                   | Yes      No  |  |   |
|                         | Dermal contact              | Yes      No  |  |   |
|                         | Inhalation                  | Yes      No  |  |   |
| Surficial Soil          | Ingestion                   | Yes      No  |  |   |
|                         | Dermal contact              | Yes      No  |  |   |
|                         | Inhalation                  | Yes      No  |  |   |
|                         | Leaching to<br>Ground-Water | Yes      No  |  |   |
| Subsurface Soil         | Ingestion                   | Yes      No  |  |   |
|                         | Dermal contact              | Yes      No  |  |   |
|                         | Volatile<br>Inhalation      | Yes      No  |  |   |
|                         | Leaching to<br>Ground-Water | Yes      No  |  |   |

**B. FUTURE LAND USE - Identify any potential receptors or human exposure pathways (e.g. basements, contaminated soils from UST closures, etc.) within a 1000-foot radius for projected future land use. Complete the table below. Additional sheets may be attached if necessary**

| Media<br>(for exposure) | Exposure Route              | Pathway Selected for<br>Evaluation? (Yes or<br>No) | Exposure point or<br>Reason for<br>Non-Selection | Data Requirements<br>(IF pathway<br>selected) |
|-------------------------|-----------------------------|--|--|---|
| Air                     | Inhalation                  | Yes      No  |  |   |
|                         | Explosion<br>Hazard         | Yes      No  |  |   |
| Ground-Water            | Ingestion                   | Yes      No  |  |   |
|                         | Dermal Contact              | Yes      No  |  |   |
|                         | Inhalation                  | Yes      No  |  |   |
| Surface Water           | Ingestion                   | Yes      No  |  |   |
|                         | Dermal contact              | Yes      No  |  |   |
|                         | Inhalation                  | Yes      No  |  |   |
| Surficial Soil          | Ingestion                   | Yes      No  |  |   |
|                         | Dermal contact              | Yes      No  |  |   |
|                         | Inhalation                  | Yes      No  |  |   |
|                         | Leaching to<br>Ground-Water | Yes      No  |  |   |
| Subsurface Soil         | Ingestion                   | Yes      No  |  |   |
|                         | Dermal contact              | Yes      No  |  |   |
|                         | Inhalation                  | Yes      No  |  |   |
|                         | Leaching to<br>Ground-Water | Yes      No  |  |   |

## UTILITY FORMAT AND POTENTIAL RECEPTOR FORMAT

## Receptor Analysis

**Describe all potential receptors and preferential pathways within a 1,000-foot radius of the site.**

| Description of Receptor<br>(Lake, Creek Potable Well) | Distance/Direction from<br>Site | Well Owner<br>(Name, Address, Telephone #) |
|---|---------------------------------|--|
|   |                                 |  |
|   |                                 |  |
|   |                                 |  |
|   |                                 |  |
|   |                                 |  |
|   |                                 |  |

## Utilities Survey

List the utilities on site, and adjacent to the site within a 500-foot radius, that could serve as exposure points or as preferential pathways.

[illegible]

## Soil Boring Data

Complete the table below for each soil boring.

[illegible][illegible]



Complete the table below for each temporary well or screening point. **For each temporary well a 1903 Form signed by a South Carolina certified well driller is required.**

Water Sample Collected Yes ☐ No ☐ Depth water sample collected  ft.

[illegible]

Water Sample Collected Yes ☐ No ☐ Depth water sample collected  ft.

[illegible]

**List The Site in addition to All Properties that Adjoin the Site Plus  
All Properties with a Monitoring Well**

**List The Site in addition to All Properties that Adjoin the Site Plus  
All Properties with a Monitoring Well**

[illegible]

South Carolina Department of Health and Environmental Control  
Bureau of Land and Waste Management, Underground Storage Tank Program  
**Groundwater Sampling Summary Information Sheet**

Date (mm/dd/yy)\_\_\_\_\_

Facility Name \_\_\_\_\_ UST Permit # \_\_\_\_\_

Name of Sampler(s)\_\_\_\_\_

County \_\_\_\_\_

### General Weather Conditions

Wells with screens that do not bracket the water table, must be purged.

Ambient Air Temperature

\* Please provide a reason in the comments section for any well not sampled

[illegible]

**Continued**

Facility Name \_\_\_\_\_ UST Permit # \_\_\_\_\_

Page \_\_\_\_ of \_\_\_\_ Pages

South Carolina Department of Health and Environmental Control  
Bureau of Land and Waste Management, Underground Storage Tank Program

## Purged Monitoring Well Data Sheet

UST Permit # \_\_\_\_\_

Well # \_\_\_\_\_

Method of Well Purging: Bailer \_\_\_\_\_ Pump type \_\_\_\_\_

Method of Sample Collection: Bailer \_\_\_\_\_ Pump type \_\_\_\_\_

Quality Assurance

pH Meter \_\_\_\_\_ Conductivity Meter \_\_\_\_\_

serial no. \_\_\_\_\_ serial no. \_\_\_\_\_

pH = 4.0 \_\_\_\_\_ Standard \_\_\_\_\_ Internal

pH = 7.0 \_\_\_\_\_ Standard \_\_\_\_\_ Internal

pH = 10.0 \_\_\_\_\_ Standard \_\_\_\_\_ Internal

Well Diameter (D) \_\_\_\_\_ Inches or \_\_\_\_\_ Feet

Conversion factor (C):  $3.1423 * (D/2)^2$

for a 2 inch well C = 0.163 for a 4 inch well C = 0.652

Total Well Depth (TWD) \_\_\_\_\_ ft. Below Ground Surface

Depth to Groundwater (DTG) \_\_\_\_\_ ft. Below Ground Surface

Screen interval \_\_\_\_\_ ft. to \_\_\_\_\_ ft.

Length of Water Column (LWC=TWD-DGW) \_\_\_\_\_ ft.

1 Csg Volume (LWC\*C) \_\_\_\_\_ X \_\_\_\_\_ = \_\_\_\_\_ gal.

3 Csg Volume = 3 X \_\_\_\_\_ = \_\_\_\_\_ gals. (Std. Purge Vol.)

Csg is Casing Volume

Total Volume of Water Purged before Sampling \_\_\_\_\_ gal.

Well Yield Low \_\_\_\_\_ Medium \_\_\_\_\_ High \_\_\_\_\_

|                        | INITIAL | 1 <sup>ST</sup> VOL. | 2 <sup>ND</sup> VOL. | 3 <sup>RD</sup> VOL. | 4 <sup>TH</sup> VOL. | 5 <sup>TH</sup> VOL. | POST | SAMPLING |
|------------------------|---------|----------------------|----------------------|----------------------|----------------------|----------------------|------|----------|
| Volume Purged (gal)    |         |                      |                      |                      |                      |                      |      |          |
| Time (military)        |         |                      |                      |                      |                      |                      |      |          |
| pH (s.u.)              |         |                      |                      |                      |                      |                      |      |          |
| Specific Cond. (mS/cm) |         |                      |                      |                      |                      |                      |      |          |
| Water Temp (°C)        |         |                      |                      |                      |                      |                      |      |          |
| Turbidity *            |         |                      |                      |                      |                      |                      |      |          |
| OVA Reading            |         |                      |                      |                      |                      |                      |      |          |
| Salinity               |         |                      |                      |                      |                      |                      |      |          |
| Dissolved Oxygen       |         |                      |                      |                      |                      |                      |      |          |

Turbidity: (1) Clear, (2) Slight, (3) Moderate, (4) High

Remarks \_\_\_\_\_

\_\_\_\_\_